FORM PTO 1390
(REV 5-93) US DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. §371

ATTORNEY DOCKET NUMBER
2001_0687A

U.S. APPLICATION NO. (if known, see 37 CFR 1.5)
NEW 09/856915

International Application No.	International Filing Date	Priority Date Claimed
PCT/JP00/06643	September 27, 2000	September 30, 1999

Title of Invention
A BIT STREAM BUFFERING AND DEMULTIPLEXING APPARATUS FOR A DVD AUDIO DECODING SYSTEM

Applicant(s) For DO/EO/US
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Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [X] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. §371.

2. [] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. §371.

3. [X] This express request to begin national examination procedures (35 U.S.C. §371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. §371(b) and PCT Articles 22 and 39(1).

4. [] A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.

5. [X] A copy of the International Application as filed (35 U.S.C. §371(c)(2))
   a. [] is transmitted herewith (required only if not transmitted by the International Bureau).
   b. [X] has been transmitted by the International Bureau. -**Attachment "A" (Form PCT/IB/308)**
   c. [] is not required, as the application was filed in the United States Receiving Office (RO/US)

6. [X] A translation of the International Application into English (35 U.S.C. §371(c)(2)).- **Attachment "B"**

7. [] Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. §371(c)(3)).
   a. [] are transmitted herewith (required only if not transmitted by the International Bureau).
   b. [] have been transmitted by the International Bureau.
   c. [] have not been made; however, the time limit for making such amendments has NOT expired.
   d. [] have not been made and will not be made.

8. [] A translation of the amendments to the claims under PCT Article 19.

9. [X] An oath or declaration of the inventor(s) (35 U.S.C. §371(c)(4)). - **Attachment "C"**

10. [] A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. §371(c)(5)).

Items 11. to 14. below concern other document(s) or information included:

11. [X] An Information Disclosure Statement under 37 CFR 1.97 and 1.98. - **Attachment "D"**

12. [X] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included. -**Attachment "E"**

13. [] A FIRST preliminary amendment.

    [] A SECOND or SUBSEQUENT preliminary amendment.

14. [X] Other items or information: Form PCT/IB/304 - **Attachment "F"**

U.S. APPLICATION NO. (if known, see 37 CFR 1.5) NEW 09/856915	INTERNATIONAL APPLICATION NO. PCT/JP00/06643	ATTORNEY'S DOCKET NO. 2001_0687A

15. [X] The following fees are submitted	CALCULATIONS	PTO USE ONLY
BASIC NATIONAL FEE (37 CFR 1.492(a)(1)-(5)):		
Neither international preliminary examination fee nor international search fee paid to USPTO and International Search Report not prepared by the EPO or JPO $1000.00		
International Search Report has been prepared by the EPO or JPO ..... $ 860.00		
International preliminary examination fee not paid ot USPTO but international search paid to USPTO ..... $ 710.00		
International preliminary examination fee paid to USPTO but claims did not satisfy provisions of PCT Article 33(1)-(4) ..... $ 690.00		
International preliminary examination fee paid ot USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) ..... $ 100.00		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$860.00	
Surcharge of $130.00 for furnishing the oath or declaration later than [] 20 [] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$	

Claims	Number Filed	Number Extra	Rate		
Total Claims	9 -20 =	--0--	X $18.00	$	
Independent Claims	3 - 3 =	--0--	X $80.00	$	
Multiple dependent claim(s) (if applicable)			+ $270.00	$	
TOTAL OF ABOVE CALCULATIONS =				$860.00	
[] Small Entity Status is hereby asserted. Above fees are reduced by 1/2.				$	
SUBTOTAL =				$860.00	
Processing fee of $130.00 for furnishing the English translation later than [] 20 [] 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +				$	
TOTAL NATIONAL FEE =				$860.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). $40 per property +				$40.00	
TOTAL FEES ENCLOSED =				$900.00	
				Amount to be refunded	$
				Amount to be charged	$

a. [X] A check in the amount of $900.00 to cover the above fees is enclosed. A duplicate copy of this form is enclosed.

b. [] Please charge my Deposit Account No. 23-0975 in the amount of $_____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. [] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 23-0975.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

19. CORRESPONDENCE ADDRESS

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3/PRTS

DESCRIPTION

A BIT STREAM BUFFERING AND DEMULTIPLEXING APPARATUS FOR A DVD AUDIO DECODING SYSTEM

TECHNICAL FIELD

This invention relates to implementation of a data buffering and demultiplexing apparatus for a DVD-Audio decoder system.

BACKGROUND ART

"DVD Specifications for Read-Only Disc Part 4 Audio Specifications Version 0.9", referred to as "DVD Audio specifications" hereinafter, specifies a new type of data stream, audio still video program stream. Audio still video stream is not multiplexed with audio program stream but stored as separate object on its own. This is different from "DVD Specifications for Read-Only Part 3 Video Specifications Version 1.1", referred to as "DVD Video specifications" hereinafter, where all elementary data streams such as audio, video and sub-picture are multiplexed into one logical program stream. An audio still video object (ASVOB) is formed from three elementary stream objects, namely, highlight information, 1 to 3 sub-pictures and still video.. An alternate form exists where an audio still video is formed only by a still video object.

A collection of audio still video objects makes up an audio still video unit (ASVU). A limited number of audio still video objects can exist in one audio still video unit. According to DVD Audio Specifications, one audio still video unit is limited to 99 audio still video objects, and the size is limited to 2 Megabytes. A collection of audio still video units makes up an audio still video stream (ASVUS).

In the DVD Audio specifications, a DVD audio decoder must buffer the whole audio still video unit in an audio still video unit buffer. Two demultiplexers capable of decoding program streams are needed. One of them demultiplexes the audio still video unit program stream from an audio still video unit buffer, and the other demultiplexes the audio program stream from a DVD Audio disc. In addition, DVD Audio specifications also stipulate that the audio still video objects in an audio still video unit can be accessed in any unknown order until the audio still video is to be presently selected. Thus, the starting location of each audio still video in an audio still video unit needs to be known.

Figure 1 shows an example of an implementation based on the decoder model specified in the DVD Audio specifications. When input data is a type of audio still video program stream, the input data is directed by a

selector to be stored (or buffered) into an audio still video buffer (ASVU Buffer) via a pre-loading terminal 0. When the buffering of the data is completed, the selector is switched back to a decoding position 1. When input data is a type of audio program stream, the data is directed to an audio program stream demultiplexer, DEMUX2 and then the demultiplexed data such as audio elementary stream is written into an audio bit buffer and other buffers such as a real time text bit buffer. At the same time, the data from the audio still video unit buffer (ASVU Buffer) is read into the other demultiplexer, DEMUX1, which demultiplexes the data to be written into video, sub-picture and highlight bit buffers. Audio still video address (ASV Address) table stores the start and/or end address of each audio still video object in the audio still video unit. These addresses are used to select the correct audio still video object to be sent to DEMUX1.

Looking at Figure 1, it is obvious that incoming data stream comprises two independent multiplexed program streams, namely, audio still video program stream and audio program stream. From a DVD Audio decoder point of view, this is different from that of a DVD Video decoder. Therefore, two program stream demultiplexers are needed for both audio still video program and audio program. This solution is more costly, because the presently existing DVD

Video decoder system only requires one demultiplexer. Alternatively, a single high speed demultiplexer that could demultiplex two streams simultaneously is needed. This would require a new demultiplexer that is capable of decoding at rate two times that of a conventional demultiplexer. Again, this is more costly than using a slower speed demultiplexer that already exists in the DVD Video decoder.

This invention discloses a method that buffers the demultiplexed audio still video unit stream after it has been demultiplexed by a program stream demultiplexer similar to that used in the current DVD Video decoder system. This means that the invention can be implemented by effectively using only one program stream demultiplexer.

In addition, the size of the bit buffers in the system for storing demultiplexed elementary stream can be reduced. This saving comes from the fact that the size of the audio still video unit after it has been demultiplexed is smaller in size than the original program stream. The other saving comes from the fact that a separate video bit buffer, sub-picture bit buffer and highlight bit buffer are not required anymore. The audio still video unit bit buffer which stores the demultiplexed elementary audio still video data is already in the bit buffer format. This also improves the time it takes to access a specific audio

still video object. It is no longer necessary to send the audio still video object to a demultiplexer first.

In a conventional system, such as a DVD Video demultiplexing of audio/video stream, the program stream is demultiplexed only when it is needed. By performing demultiplexing early during pre-loading of audio still video unit program stream into the audio still video unit bit buffer, the system can detect potential bit stream syntax error in advance, before the data is decoded.

DISCLOSURE OF INVENTION

For the purpose of solving the above-described problems, the bit stream buffering and demultiplexing architecture according to the present invention was designed.

In order to keep the cost of the DVD Audio decoder down by not adding additional demultiplexer in the system, a buffering method which demultiplexes the audio still video unit program stream during the pre-loading to the audio still video unit bit buffer is invented. In order to reduce the amount of bit-stream buffers used in a decoder system, a means for bit buffer memory sharing is invented. In order to help the decoder system better manages bit-stream errors, error checking the program stream syntax during demultiplexing allow the decoder to

detect stream error early, before the DVD Audio decoder needs to present any data to the user. In order to speed up access time in accessing a particular audio still video object from the audio still video unit bit buffer, demultiplexed audio still video unit program stream is stored in the audio still video unit bit buffer. The address locations of each object in an audio still video unit are easily available to speed up accesses as well.

According to an essential feature of the present invention, a bit stream buffering and demultiplexing apparatus for a DVD Audio decoding system comprises: a demultiplexer for demultiplexing a coded program stream to elementary streams; an audio still video unit bit buffer for storing demultiplexed audio still video program streams; a bit stream buffer for storing demultiplexed audio program stream, and an audio still video object address pointer table storing address locations of the demultiplexed audio still video program streams.

In this construction, the audio still video object address pointer table may further store status information of the demultiplexed audio still video program streams.

Also, the demultiplexer may comprise: a means for demultiplexing the coded program stream to elementary streams, and a means for switching of writing to

said audio still video unit bit buffer from said bit stream buffers, the switching occurring whenever input bitstream is audio still video program stream.

Also, the audio still video unit bit buffer for storing the demultiplexed audio still video bit streams may comprise: a means for storing elementary streams of audio still video, and a means for storing start address pointers of all or sub group of elementary streams of an audio still video unit.

In this construction, the audio still video unit bit buffer further may comprise a means for storing status information relating to all or sub group of an audio still video unit.

Also, the audio still video address pointer table may comprise: a means for storing start and/or end address pointers of all or sub group of elementary streams of an audio still video unit, and a means for storing status information relating to all or sub group of an audio still video unit.

Moreover, the status information storing means may comprise: a means for storing syntax error information, and a means for storing other information related to the audio still video unit.

Another aspect of the present invention provides a bit stream buffering and demultiplexing method for a DVD

Audio decoding system, which comprises the steps of: demultiplexing a coded program stream to elementary streams; storing demultiplexed audio still video program streams; storing demultiplexed audio program stream, and storing address locations of the demultiplexed audio still video program streams, wherein the demultiplexing step includes a step of demultiplexing the audio still video unit program stream during a pre-loading to the audio still video unit bit buffer.

Further another aspect of the present invention provides a DVD Audio decoding system having a bit stream buffer and a demultiplexer, wherein the multiplexer is only one demultiplexer which generates an audio still video address pointer table indicating an access address for each audio still video object, to demultiplex both audio program stream and audio still video program stream, and the bit stream buffer comprises means for storing demultiplexed audio still video data in an elementary format.

The DVD Audio decoder system reads in bit stream from the DVD Audio disc and sends it to the demultiplexer. For the DVD Audio decoder, audio still video unit program stream is read from the disc first and passes to the demultiplexer. The demultiplexer strips off the program stream layer and stores elementary video, highlight information and sub-picture streams in the audio still

video unit bit buffer. This is done during the audio still video unit pre-loading specified in the DVD Audio specifications. The demultiplexer also checks the structure of the audio still video program stream to make sure it conforms to the structure outlined in DVD Audio specifications. Bit stream errors are reported to the system. The demultiplexer also keeps track of the location of each audio still video objects demultiplexed. These address locations are buffered to allow random access to specific audio still video object during audio program decoding. After the decoder completes the pre-loading process, audio program stream is read from the DVD Audio disc. The same demultiplexer then demultiplexes the audio program stream that contains audio and other optional streams such as real-time text. Demultiplexed elementary data are stored in appropriate bit buffers.

From the audio bit buffers, audio decoder reads the audio elementary stream, decodes and presents the data out. At the same time, using the audio still video objects address stored in the pointer table, the video, sub-picture and highlight information decoders read in the appropriate audio still video object, decode and present the data to the user. The presentation order of the audio still video objects depends on presentation information stored in the DVD Audio disc or from the interactive controls of the DVD

Audio decoder system user.

BRIEF DESCRIPTION OF DRAWINGS

These and other objects and features of the present invention will be readily understood from the following detailed description taken in conjunction with preferred embodiments thereof with reference to the accompanying drawings, in which like parts are designated by like reference numerals and in which:

Figure 1 is a prior-art of the current invention;

Figure 2 is an example embodiment of the invented DVD Audio stream buffering and demultiplexing system;

Figure 3 is an example configuration of the audio still video object address pointer table and audio still video unit bit buffer mapping of the embodiment of Figure 2; and

Figure 4 is another example configuration of the audio still video object address pointer table and audio still video unit bit buffer mapping of the embodiment of Figure 2.

Best Mode for Carrying Out the Invention

Before the description proceeds, it is to be noted that, since the basic structures of the preferred embodiments are in common, like parts are designated by the

same reference numerals throughout the accompanying drawings.

An example of an embodiment of the present invention is described with reference to Figure 2. In Figure 2, a program stream comes in from a program stream input terminal 100 to a demultiplexer, DEMUX 101. The input stream is multiplexed according to ISO13818-1 MPEG-2 Program Stream Standard as well as to DVD Audio and Video specifications. DEMUX 101 demultiplexes the program stream into elementary data streams. For the current embodiment of the present invention, but not limited by this, DEMUX supports demultiplexing into the following elementary streams: video, sub-picture, highlight information, audio and other data such as real-time text. The DEMUX 101 demultiplexes the input stream and then the demultiplexed elementary data streams are written into video bit buffers 107, sub-picture bit buffers 108, highlight bit buffers 109, audio bit buffer 110 and other buffers 111 such as real-time text bit buffer.

In this embodiment, video buffers are logical buffers that store all the video objects of all the audio still video objects contained in an audio still video unit. The same is said for sub-picture bit buffers and highlight bit buffers. These 3 groups of bit buffers make up the audio still video unit bit buffer 300. More details on the mapping of this buffer shall be stated later.

There are two types of multiplexed program streams input from the input terminal 100 to DEMUX 101. Audio still video unit stream is a multiplexed of video, sub-picture and highlight data. Audio program stream is a multiplexed of audio and real-time text data. Accordingly, DEMUX 101 may include a switch means for switching the writing of the demultiplexed program streams between the audio still video unit bit buffer (300) and the bit stream buffers (110, 111) in accordance with the types of the input program streams. A selector as shown in Figure 1 may be used as a switch means. Thus, when the input data is a type of audio still video program stream, the demultiplexed data output of DEMUX 101 is directed by the selector to be stored in the audio still video unit bit buffer (300). When the input data is a type of audio program stream, the demultiplexed data output of DEMUX 101 is directed to the bit stream buffers (110, 111).

When the system is performing audio still video pre-loading, audio still video program stream is inputted to DEMUX. DEMUX writes the demultiplexed data via buses 102, 103 and 104 into the respective bit buffers 107, 108 and 109 in the audio still video unit buffer 300. This unit buffer is similar to the ASVU buffer stated in the prior art shown in Fig. 1 except that the elementary data streams are stored instead. During the demultiplexing of

audio still video program stream, DEMUX also calculates the start and end location of each video, sub-picture and highlight elementary streams and stores these addresses in an audio still video object address pointer table 200. This table is essential for random accessing of audio still video object during the decoding phase (or mode) of the decoder.

During audio still video unit demultiplexing, DEMUX can perform various types of stream integrity check such as program stream syntax check or audio still video stream structure check. The number of audio still video objects can be counted and then confirmed with the number stored elsewhere in the disc. The order of video, sub-picture and highlight in an audio still video object can also be double-checked to confirm the validity of the stream. The size of the audio still video unit can also be confirmed against the limit set by the Specification. All these information can provide good indication to the decoder as to the data integrity of the disc.

When the system completes audio still video pre-loading, the system inputs audio program stream to start audio decoding. During this time, DEMUX demultiplexes the audio program stream into audio and real-time text elementary streams, and stores the elementary streams data into their respective bit buffers 110 and 111 via buses 105

and 106. At this time, the video, sub-picture, highlight, audio and real-time text elementary streams are read from their respective bit buffers simultaneously and sent to their respective decoder for decoding. The video, sub-picture and highlight elementary streams are accessed depending on which audio still video object within the audio still video unit has been selected for decoding. This information may not be known until 0.4 second before the audio still video object is to be presented, according to DVD Audio Specifications. The audio still video object address pointer table 200 stores the information needed by the decoder to read the correct data from the audio still video unit bit buffer 300.

Figure 3 shows an embodiment of the audio still video object address pointer table 200 and the audio still video unit bit buffer 300. In this embodiment, DEMUX stores the start address pointer of each audio still video object (ASVOB 1-99) it encounters when demultiplexing the audio still video unit program stream as in the audio still video object address pointer table 200. Each of the start addresses in turn points to a start position of each of the audio still video objects stored in the audio still video unit bit buffer 300. The beginning portion of each audio still video object in the audio still video bit buffer further contains pointer addresses that point to the start

of sub-picture bit buffer and video bit buffer for that particular audio still video object. Highlight bit buffer does not need pointer address as it immediately follows the video pointer addresses and status information data. It is noted here that the audio still video address pointer table (200) may store start and/or end address pointers of all or sub group of elementary streams of an audio still video unit.

Referring to Figure 3, as to an audio still video object 1 (ASVOB1), an address pointer 201 in the address pointer table 200 points to the beginning of the audio still video object 1 (ASVOB1) in the audio still video bit buffer 300. An arrow line 202 indicates this pointer in Figure 3. The sub-picture address pointer 203 for ASVOB1 in turn points to a start location of a sub-picture bit buffer 206 for ASVOB1, and an arrow line 208 shows this pointer. A video address pointer 204 for ASVOB1 immediately after the sub-picture address pointer 203 points to a start location of a video bit buffer 207 for ASVOB1, and an arrow line 209 shows this pointer. Immediately after the video address pointer 204 for ASVOB1, extra status information of ASVOB1 is stored indicative of such as whether the current audio still video object contains valid highlight data, or syntax error information. Numeral 301 shows the status information for ASVOB1. A

highlight bit buffer 205 for ASVOB1 follows immediately after the status information 301 for ASVOB1. In cases when no highlight data or sub-picture exist, setting sub-picture pointer address to 0 will indicate that only a video bit buffer exists in the bit stream.

For most implementation, the audio still video address pointer table would be implemented using an internal static random access memory. For the audio still video unit bit buffer, due to its larger size, it is usually implemented as part of a system memory in an external dynamic random access memory. This particular embodiment for the audio still video address pointer table allows part of the address pointer to be stored in the cheaper dynamic random access memory typically used for audio still video unit bit buffer. The trade off for such system would be longer time to access the addresses to the audio still video objects.

Figure 4 shows an alternate embodiment of the audio still video object address pointer table 200 and audio still video unit bit buffer 300, related to current invention. In this embodiment, the audio still video object address pointer table contains the address pointers needed to access each audio still video objects in the audio still video unit bit buffer. The table also contains extra status information of each audio still video object

to store syntax error information and extra status data.

Unlike previous embodiment in Figure 3, all pointer addresses to access the audio still video objects are stored in the pointer table 200. This embodiment has an advantage of faster accesses to audio still video object start address, with tradeoff of a larger pointer table. The audio still video object start address points to the start address of the specific audio still video object in the audio still video unit buffer. This also points to the highlight bit buffer of the specified audio still video object (ASVOB). The video address pointer points to the specific video bit buffer of the specified audio still video object in the audio still video bit buffer. The start address of each sub-picture bit buffer is calculated indirectly from the audio still video object address pointer.

In this embodiment, size of the highlight bit buffer is limited to 704bytes. Accordingly, the start address of sub-picture bit buffer is 704bytes offset from the start of highlight bit buffer. In the case when no valid highlight information exists in the bit buffer, the status information field for the specific audio still video object will indicate such condition and video address pointer will have value equal to highlight bit buffer start address offset by 704bytes.

The decoder uses the address information stored in the audio still video address pointer table and/or the audio still video unit bit buffer to access the correct audio still video object bit buffers quickly. This is very important for implementing fast random access functions for audio still videos.

Although the present invention has been described in connection with the preferred embodiments thereof with reference to the accompanying drawings, it is to be noted that various changes and modifications will be apparent to those skilled in the art. Such changes and modifications are to be understood as included within the scope of the present invention as defined by the appended claims, unless they depart therefrom.

INDUSTRIAL APPLICABILITY

The effect of this invention is a cost efficient implementation of a bit stream buffering and demultiplexing system for DVD Audio decoder system. This is due to the use of only one demultiplexer. Storing of audio still video unit in an elementary form also have the advantages of reducing the size of bit buffer memories and speeding up access to the audio still video object data.

CLAIMS

1. A bit stream buffering and demultiplexing apparatus for a DVD Audio decoding system comprising:

a demultiplexer for demultiplexing a coded program stream to elementary streams;

an audio still video unit bit buffer for storing demultiplexed audio still video program streams;

a bit stream buffer for storing demultiplexed audio program stream, and

an audio still video object address pointer table storing address locations of the demultiplexed audio still video program streams.

2. A bit stream buffering and demultiplexing apparatus according to claim 1, wherein said audio still video object address pointer table further stores status information of the demultiplexed audio still video program streams.

3. A bit stream buffering and demultiplexing apparatus according to claim 1, wherein said demultiplexer comprises:

a means for demultiplexing the coded program stream to elementary streams, and

a means for switching of writing to said audio still video unit bit buffer from said bit stream buffers, said switching occurring whenever input bitstream is audio

still video program stream.

4. A bit stream buffering and demultiplexing apparatus according to claim 1, wherein said audio still video unit bit buffer for storing the demultiplexed audio still video bit streams comprises: a means for storing elementary streams of audio still video, and a means for storing start address pointers of all or sub group of elementary streams of an audio still video unit.

5. A bit stream buffering and demultiplexing apparatus according to claim 4 , wherein said audio still video unit bit buffer further comprises a means for storing status information relating to all or sub group of an audio still video unit.

6. A bit stream buffering and demultiplexing apparatus according to claim 1 , wherein said audio still video address pointer table comprises: a means for storing start and/or end address pointers of all or sub group of elementary streams of an audio still video unit, and a means for storing status information relating to all or sub group of an audio still video unit.

7. A bit stream buffering and demultiplexing apparatus according to claim 6, wherein said status information storing means comprises: a means for storing syntax error information, and a means for storing other information related to the audio still video unit.

8. A bit stream buffering and demultiplexing method for a DVD Audio decoding system, comprising the steps of:

demultiplexing a coded program stream to elementary streams;

storing demultiplexed audio still video program streams;

storing demultiplexed audio program stream, and

storing address locations of the demultiplexed audio still video program streams,

wherein the demultiplexing step includes a step of demultiplexing the audio still video unit program stream during a pre-loading to the audio still video unit bit buffer.

9. A DVD Audio decoding system having a bit stream buffer and a demultiplexer,

said multiplexer is only one demultiplexer which generates an audio still video address pointer table indicating an access address for each audio still video object, to demultiplex both audio program stream and audio still video program stream,

said bit stream buffer comprising means for storing demultiplexed audio still video data in an elementary format.

ABSTRACT

An apparatus for bit stream buffering and demultiplexing for a DVD Audio decoder system uses one demultiplexer to demultiplex both audio program stream and audio still video program stream. Demultiplexed audio still video data is stored in the elementary form of ASVU buffer. Storing elementary data as ASVU buffer reduces the storage space and allows the system to check for syntax error in the program stream level earlier. The demultiplexer also generates an audio still video address pointer table indicating the access address for each audio still video object, thus allowing fast random access by the decoder.

Fig.1

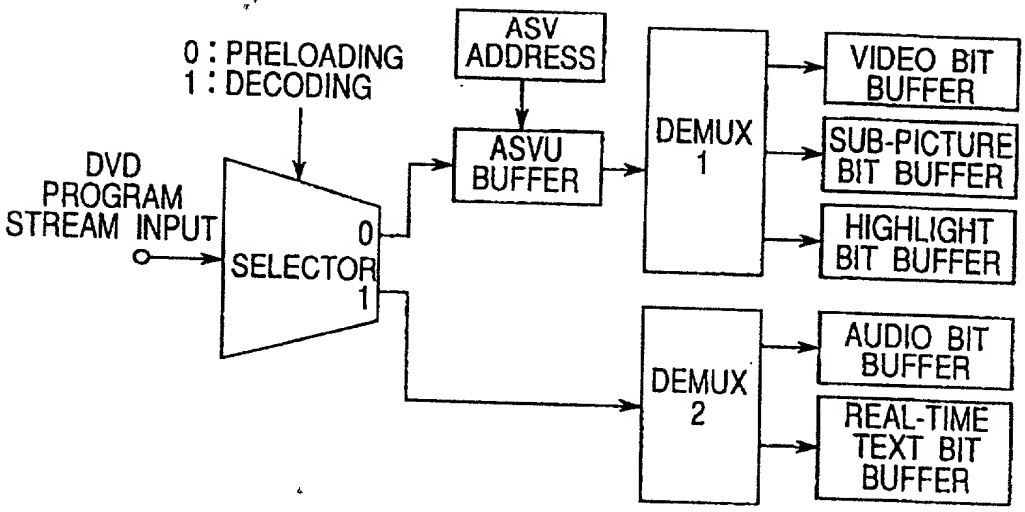

0 : PRELOADING
1 : DECODING
ASV ADDRESS
DVD PROGRAM STREAM INPUT
SELECTOR
0
1
ASVU BUFFER
DEMUX 1
VIDEO BIT BUFFER
SUB-PICTURE BIT BUFFER
HIGHLIGHT BIT BUFFER
DEMUX 2
AUDIO BIT BUFFER
REAL-TIME TEXT BIT BUFFER

Fig.2

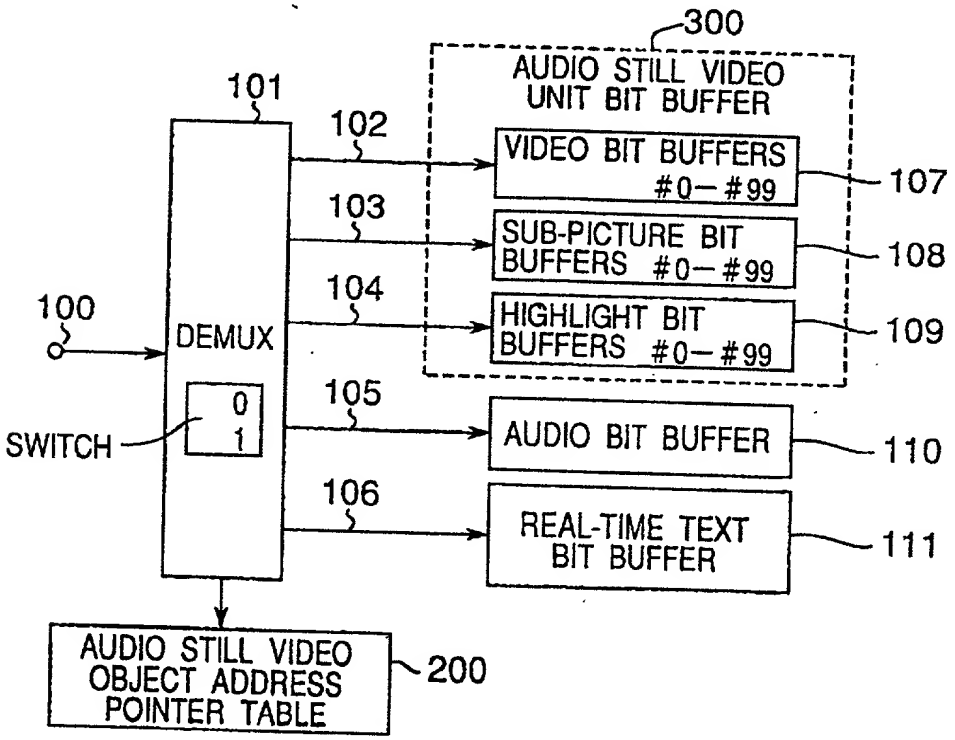

300
AUDIO STILL VIDEO UNIT BIT BUFFER
101
102
103
104
105
106
100
DEMUX
SWITCH
0
1
VIDEO BIT BUFFERS #0—#99
SUB-PICTURE BIT BUFFERS #0—#99
HIGHLIGHT BIT BUFFERS #0—#99
AUDIO BIT BUFFER
REAL-TIME TEXT BIT BUFFER
107
108
109
110
111
AUDIO STILL VIDEO OBJECT ADDRESS POINTER TABLE
200

Fig.3

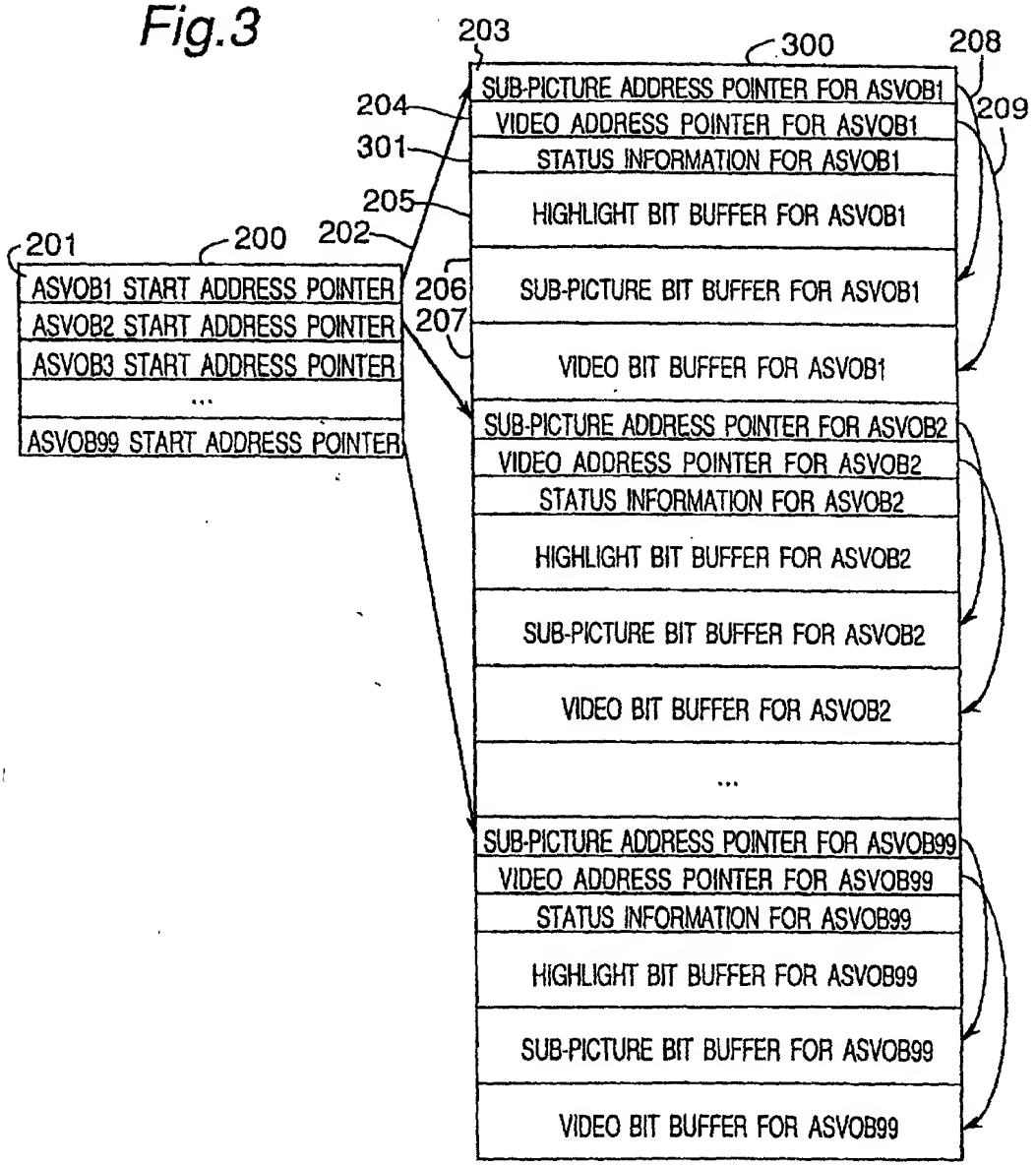
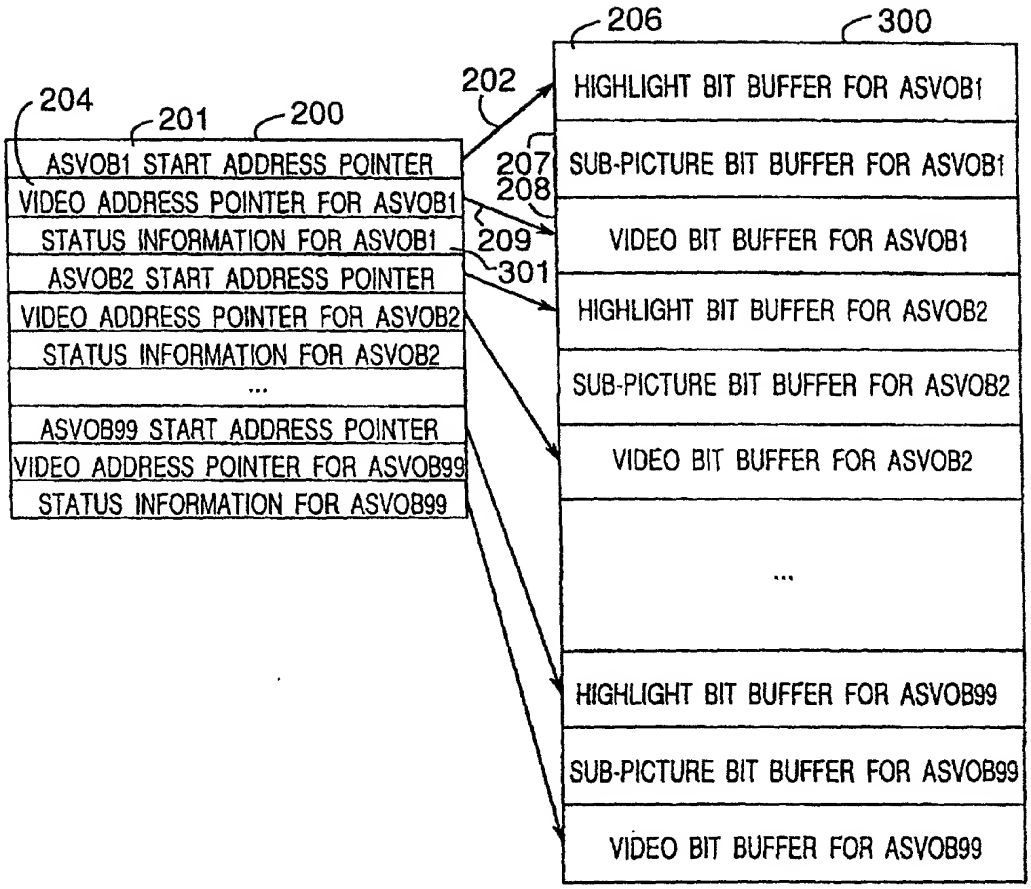

201
200
202
ASVOB1 START ADDRESS POINTER
ASVOB2 START ADDRESS POINTER
ASVOB3 START ADDRESS POINTER
...
ASVOB99 START ADDRESS POINTER
203
300
208
209
204
301
205
206
207
SUB-PICTURE ADDRESS POINTER FOR ASVOB1
VIDEO ADDRESS POINTER FOR ASVOB1
STATUS INFORMATION FOR ASVOB1
HIGHLIGHT BIT BUFFER FOR ASVOB1
SUB-PICTURE BIT BUFFER FOR ASVOB1
VIDEO BIT BUFFER FOR ASVOB1
SUB-PICTURE ADDRESS POINTER FOR ASVOB2
VIDEO ADDRESS POINTER FOR ASVOB2
STATUS INFORMATION FOR ASVOB2
HIGHLIGHT BIT BUFFER FOR ASVOB2
SUB-PICTURE BIT BUFFER FOR ASVOB2
VIDEO BIT BUFFER FOR ASVOB2
...
SUB-PICTURE ADDRESS POINTER FOR ASVOB99
VIDEO ADDRESS POINTER FOR ASVOB99
STATUS INFORMATION FOR ASVOB99
HIGHLIGHT BIT BUFFER FOR ASVOB99
SUB-PICTURE BIT BUFFER FOR ASVOB99
VIDEO BIT BUFFER FOR ASVOB99

Fig.4


206
300
202
204
201
200
ASVOB1 START ADDRESS POINTER
VIDEO ADDRESS POINTER FOR ASVOB1
STATUS INFORMATION FOR ASVOB1
ASVOB2 START ADDRESS POINTER
VIDEO ADDRESS POINTER FOR ASVOB2
STATUS INFORMATION FOR ASVOB2
...
ASVOB99 START ADDRESS POINTER
VIDEO ADDRESS POINTER FOR ASVOB99
STATUS INFORMATION FOR ASVOB99
207
208
209
301
HIGHLIGHT BIT BUFFER FOR ASVOB1
SUB-PICTURE BIT BUFFER FOR ASVOB1
VIDEO BIT BUFFER FOR ASVOB1
HIGHLIGHT BIT BUFFER FOR ASVOB2
SUB-PICTURE BIT BUFFER FOR ASVOB2
VIDEO BIT BUFFER FOR ASVOB2
...
HIGHLIGHT BIT BUFFER FOR ASVOB99
SUB-PICTURE BIT BUFFER FOR ASVOB99
VIDEO BIT BUFFER FOR ASVOB99

DECLARATION AND POWER OF ATTORNEY FOR U. S. PATENT APPLICATION

( ) Original ( ) Supplemental ( ) Substitute (X) PCT ( ) Design

As a below named inventor, I hereby declare that: my residence, post office address and citizenship are as stated below next to my name; that I verily believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural inventors are named below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Title: A BIT STREAM BUFFERING AND DEMULTIPLEXING APPARATUS FOR A DVD AUDIO DECORDING SYSTEM

of which is described and claimed in:

( ) the attached specification, or

( ) the specification in the application Serial No. _____ filed _____;
and with amendments through _____ (if applicable), or

(X) the specification in International Application No. PCT/JP00/06643, filed Sep. 27, 2000 and as amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment(s) referred to above.

I acknowledge my duty to disclose to the Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

I hereby claim priority benefits under Title 35, United States Code, §119 (and §172 if this application is for a Design) of any application(s) for patent or inventor's certificate listed below and have also identified below any application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

COUNTRY	APPLICATION NO.	DATE OF FILING	PRIORITY CLAIMED
Japan	11-279150	September 30, 1999	YES

I hereby claim the benefit under Title 35, United States Code §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code §112, I acknowledge the duty to disclose information material to patentability as defined in Title 37, Code of Federal Regulations, §1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

APPLICATION SERIAL NO.	U.S. FILING DATE	STATUS: PATENTED, PENDING, ABANDONED

Attachment "C"

(7)

And I hereby appoint John T. Miller, Reg. No. 21,120; Michael R. Davis, Reg. No. 25,134; Matthew M. Jacob, Reg. No. 25,154; Jeffrey Nolton, Reg. No. 25,408; Warren M. Cheek, Jr., Reg. No. 33,367; Nils E. Pedersen, Reg. No. 33,145 and Charles R. Watts, Reg. No. 33,142, who together constitute the firm of WENDEROTH, LIND & PONACK, L.L.P., attorneys to prosecute this application and to transact all business in the U.S. Patent and Trademark Office connected therewith.

I hereby authorize the U.S. attorneys named herein to accept and follow instructions from AOYAMA & PARTNERS as to any action to be taken in the U.S. Patent and Trademark Office regarding this application without direct communication between the U.S. attorneys and myself. In the event of a change in the persons from whom instructions may be taken, the U.S. attorneys named herein will be so notified by me.

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1-00

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2-00

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4-00

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5-00

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Residence & Citizenship	CITY	STATE OR COUNTRY	COUNTRY OF CITIZENSHIP	
Post Office Address	ADDRESS	CITY	STATE OR COUNTRY	ZIP CODE

I further declare that all statements made herein of my own knowledge are true, and that all statements on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

1st Inventor Sau Tsien LIM Date April 20, 2001

2nd Inventor Makoto Meiarashi Makoto MEIARASHI Date May 14, 2001

3rd Inventor Katsumi Hoashi Katsumi HOASHI Date May 25. 2001

4th Inventor Ryoji Yamaguchi Ryoji YAMAGUCHI Date May 25. 2001

5th Inventor Ken Monda Ken MONDA Date May 7, 2001

6th Inventor _____ Date _____

7th Inventor _____ Date _____

The above application may be more particularly identified as follows:

U.S. Application Serial No. _____ Filing Date _____

Applicant Reference Number 533372 MaA Atty Docket No. _____

Title of Invention A BIT STREAM BUFFERING AND DEMULTIPLEXING APPARATUS FOR A DVD AUDIO DECODING SYSTEM